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(54) POWER CONNECTOR WITH VERTICAL MALE AC POWER CONTACTS

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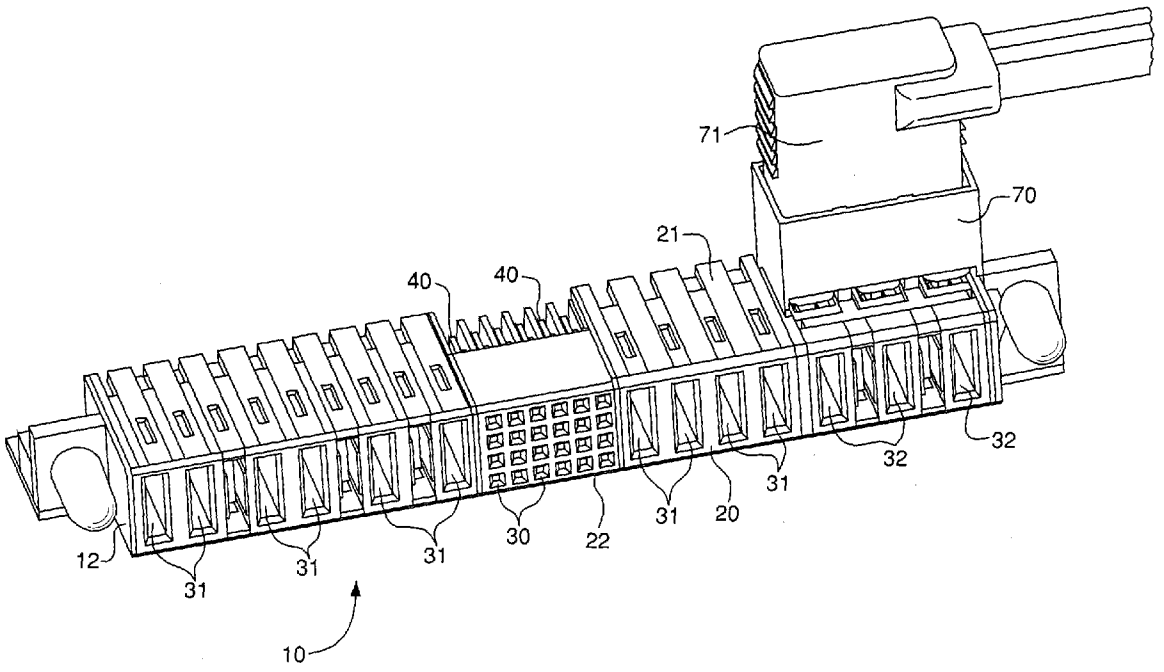
(57) ABSTRACT

Electrical connectors are provided for transmitting electrical power. A preferred connector comprises an insulative housing and a plurality of AC power contacts disposed therein. The insulative housing comprises a circuit board facing portion and a mating face including a plurality of apertures. Each of the AC power contacts comprises an engaging portion accessible through one of the apertures for engagement with a complementary contact associated with a mating connector. A tab extends from the engaging portion of each of the AC power contacts that protrudes from the insulative housing at a position farthest from the circuit board facing portion for engagement with an AC cable plug.



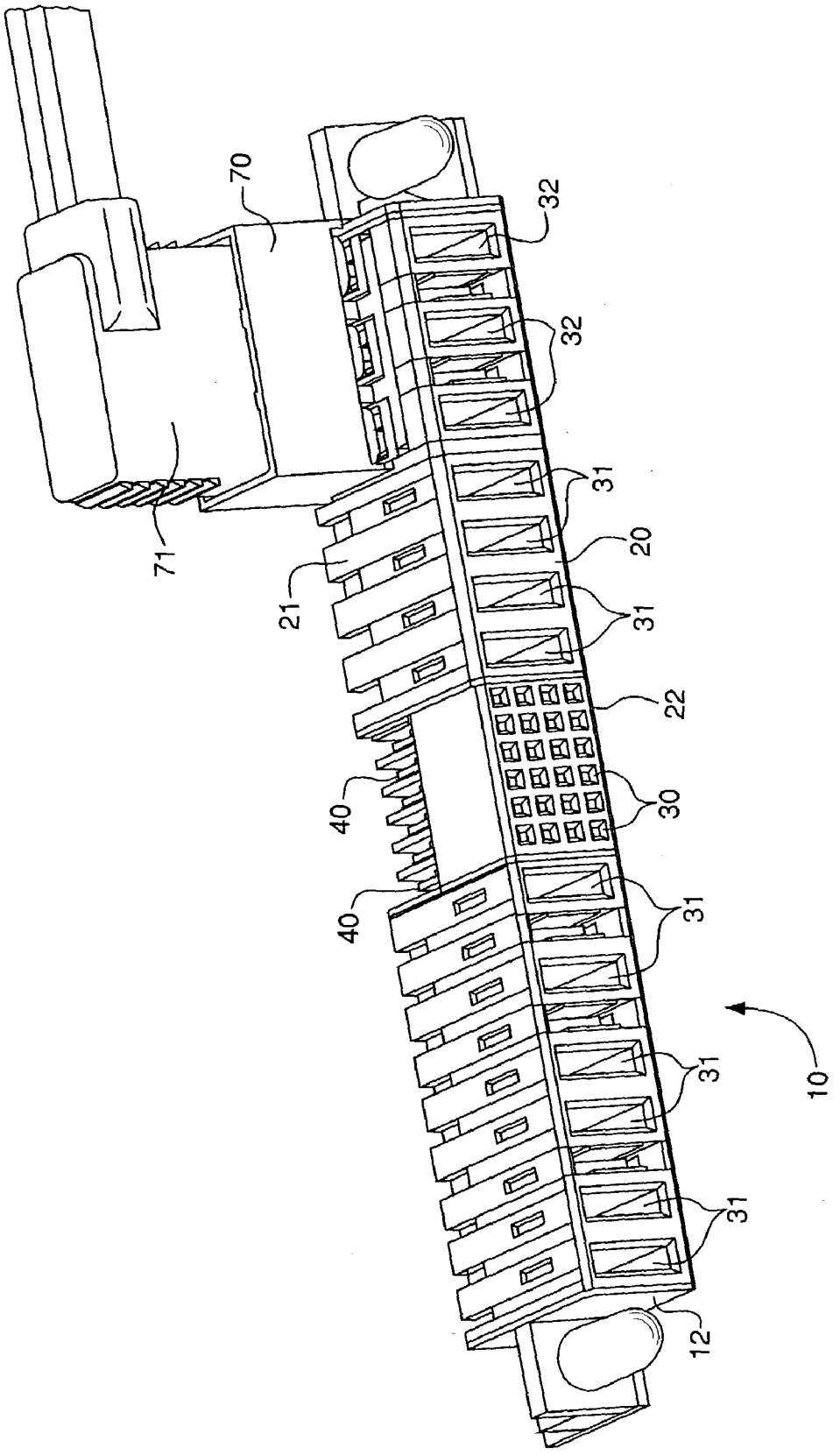


FIG. 1

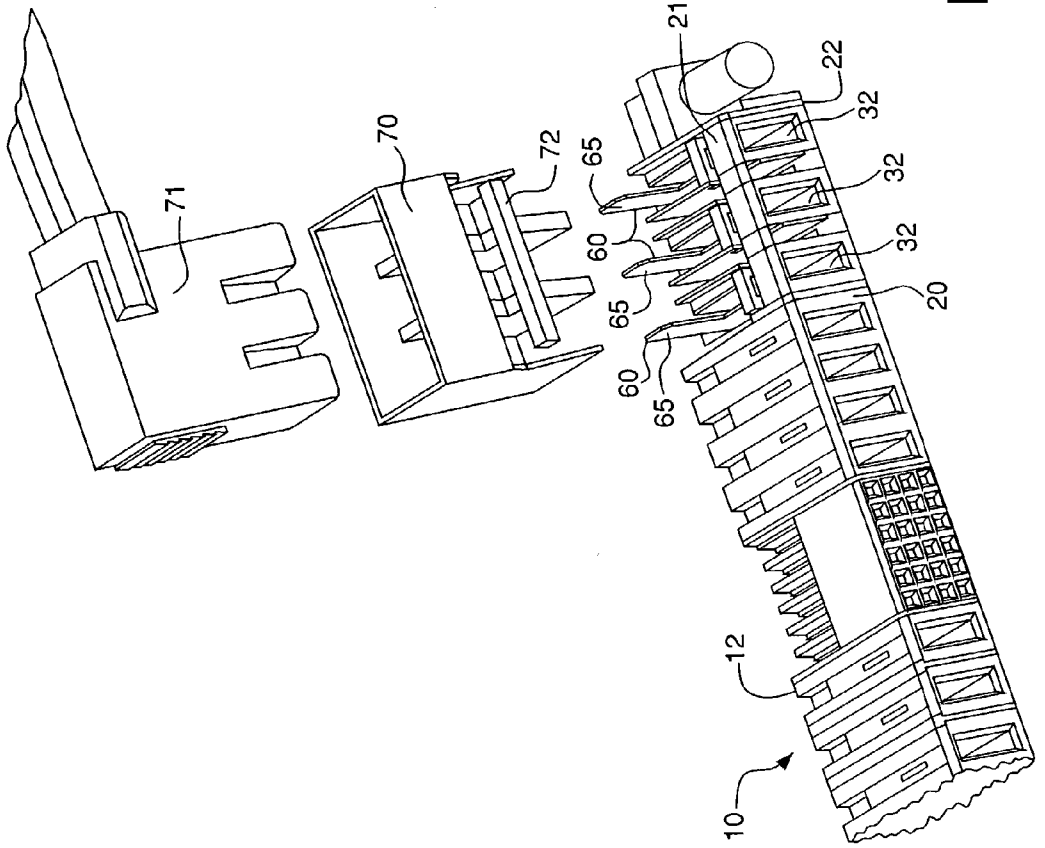


FIG. 2

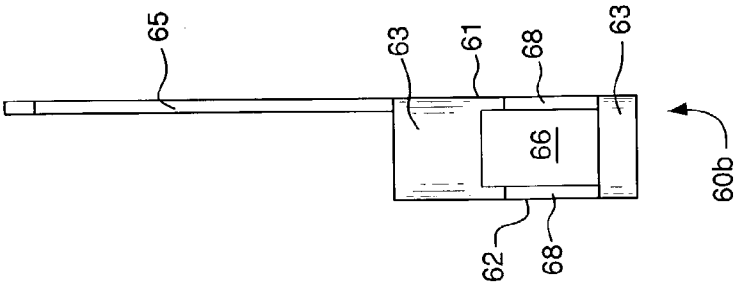


FIG. 3C

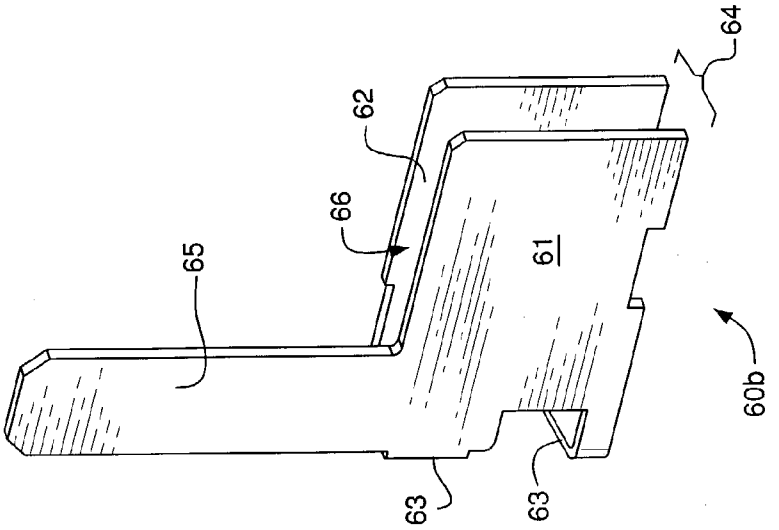


FIG. 3B

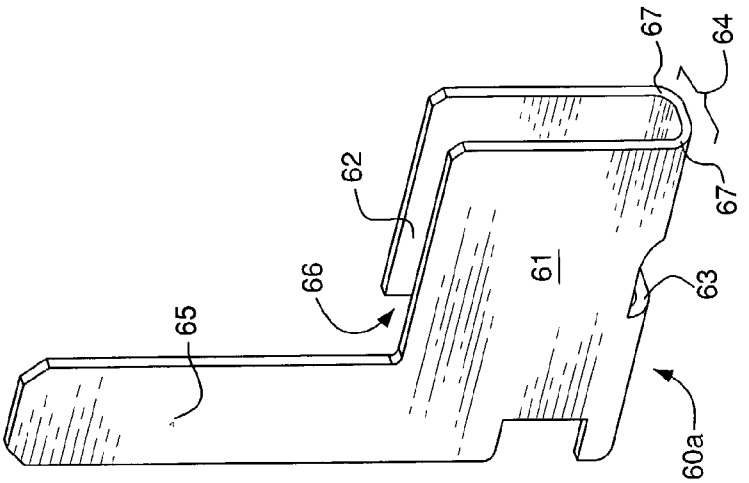


FIG. 3A

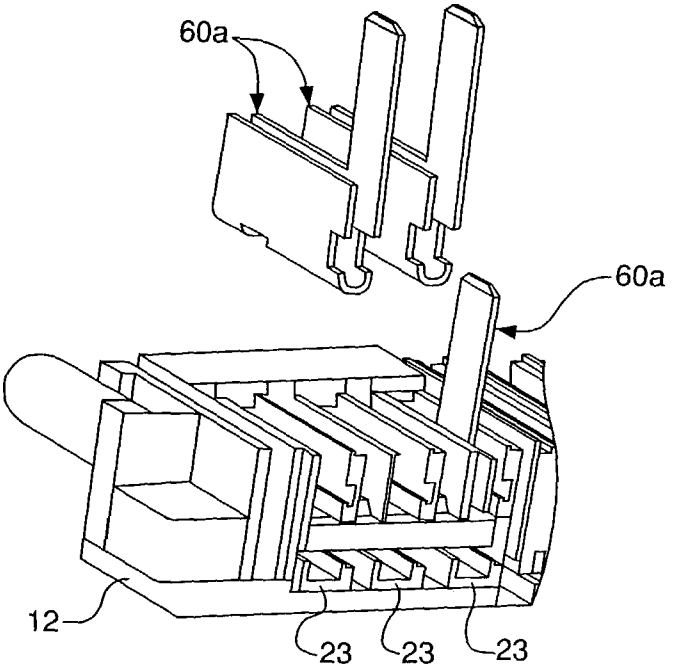


FIG. 4

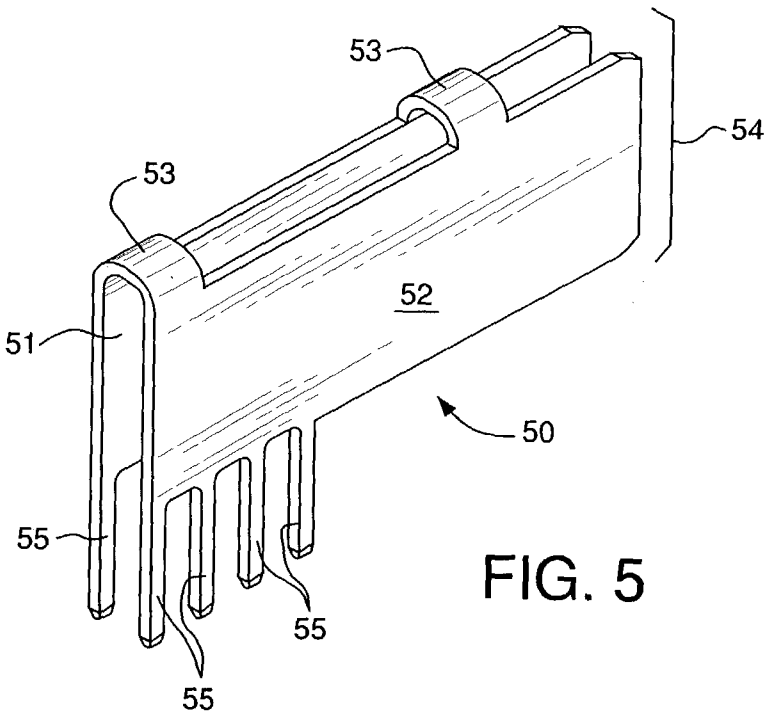


FIG. 5

POWER CONNECTOR WITH VERTICAL MALE AC POWER CONTACTS

FIELD OF THE INVENTION

[0001] The present invention is related to connectors for transmitting electrical power.

BACKGROUND OF THE INVENTION

[0002] There has been significant evolution in the area of electrical connectors, with improvements including multi-function consolidation within a single connector housing, and employment of features for effective heat dissipation generated from electrical power transmission. For example, Clark et al., in U.S. Pat. No. 6,319,075, disclose an electrical connector including both power and signal contacts within a single insulative housing, thereby eliminating the need for two separate connectors. Preferred power contacts disclosed in the '075 patent employ a "dual-mass" principle that provides a greater surface area available for heat dissipation, as compared to "single-mass" designed contacts, such as, for example, those having a circular or pin-like cross section.

[0003] Electrical connectors similar to those above may further comprise an AC power cable port and AC power contacts for direct connection with an external power supply. Examples of such connectors are commercially available from FCI Electronics, Inc. FCI's PWRBLADE brand connector series includes a receptacle connector that consists of AC power contacts, DC power contacts, signal contacts, and a shrouded AC cable port. Each of the power contacts includes two contact walls with a space therebetween to facilitate heat dissipation. Two patent applications owned by the assignee of the instant application and generally related to power distribution connectors, U.S. patent application Ser. No. 09/160,900 filed Sep. 25, 1998 and Ser. No. 09/944,266 filed Aug. 31, 2001, are currently pending in the U.S. Patent & Trademark Office, and are incorporated by reference herein.

[0004] Although a useful contribution to the art, the AC power contacts and AC cable port in applicant's co-pending '266 patent extend from and terminate at the rear portion of the connector housing. Valuable circuit board space to which the connector is coupled is compromised with this connector configuration because space and access must be provided for an AC power cable plug that engages the AC power contacts. This configuration also increases the possibility of electrical creepage due to the close proximity between the circuit board and the AC cable port and a corresponding AC power cable plug. Accordingly, there is room for improvement in the art.

SUMMARY OF THE INVENTION

[0005] The present invention is related to electrical connectors having contacts for transmitting electrical power. In accordance with a preferred embodiment of the present invention, there has now been provided an electrical power connector comprising an insulative housing and a plurality of AC power contacts disposed in the insulative housing. The insulative housing comprises a circuit board facing portion and a mating face including a plurality of apertures therein. Each of the AC power contacts comprises an engaging portion accessible through one of the plurality of apertures for engagement with a complementary contact, and a tab extending from the engaging portion and protruding from the insulative housing at a position farthest from the circuit board facing portion for engagement with an AC cable plug.

[0006] In accordance with another preferred embodiment of the present invention, there has now been provided a an electrical power connector comprising an insulative housing, a DC power contact disposed in the insulative housing, and an AC power contact disposed in the insulative housing. The insulative housing comprises a mating face including a plurality of apertures therein. The DC power contact includes an engaging portion that is accessible through one of the plurality of apertures and is configured for engagement with a contact from a mating connector, and at least one terminal extending from the engaging portion for connection to a circuit board. The AC power contact includes an engaging portion that is accessible through another of the plurality of apertures and is configured for engagement with a contact from a mating connector, and a tab extending from the engaging portion for engagement with an AC cable plug. The at least one terminal and the tab extend in opposite directions.

[0007] In accordance with yet another preferred embodiment of the present invention, there has now been provided an electrical power connector comprising an insulative housing, a plurality of AC power contact disposed in the housing, and a shrouded AC cable port. The insulative housing comprises a top portion, a bottom portion, and a mating face extending therebetween. The mating face includes a plurality of apertures therein for receiving contacts from a mating connector. Each of the AC power contacts includes an engaging portion comprising two spaced apart walls that are accessible through one of the plurality of apertures and a tab extending from only one of the two spaced apart walls. The shrouded AC cable port extends from the top portion of the insulative housing, encompasses the AC power contact tabs, and is configured for receiving an AC cable plug.

[0008] These and various other features of novelty, and their respective advantages, are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for a better understanding of aspects of the invention, reference should be made to the drawings which form a further part hereof, and to the accompanying descriptive matter, in which there is illustrated preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] **FIG. 1** is a perspective view of a preferred connector embodiment provided by the present invention, with a power cable plug engaged therewith.

[0010] **FIG. 2** is a partial, exploded view of the connector embodiment shown in **FIG. 1**.

[0011] **FIG. 3A** is a perspective view of a preferred AC power contact embodiment provided by the present invention.

[0012] **FIG. 3B** is a perspective view of another preferred AC power contact embodiment provided by the present invention.

[0013] **FIG. 3C** is a rear view of the AC power contact embodiment shown in **FIG. 3B**.

[0014] **FIG. 4** is a partial, rear perspective view of a connector embodiment illustrating AC power contacts being loaded into the connector housing.

[0015] **FIG. 5** is a perspective view of a preferred DC power contact embodiment provided by the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0016] The present invention is believed to be best understood through the following detailed description of preferred embodiments and the accompanying drawings wherein like reference numbers indicate like features. Referring to **FIGS. 1 and 2**, an electrical power connector **10** is shown including an insulative housing **12** having a mating face **20** for receiving a complimentary electrical connector (not shown). Mating face **20** contains a plurality of apertures that provide access to electrical contacts disposed in insulative housing **12**. For example, apertures **30** provide access to engaging portions of signal contacts **40**, apertures **31** provide access to engaging portions of DC power contacts **50** (shown in **FIG. 5**), and apertures **32** provide access to engaging portions of AC power contacts **60** (details shown in FIGS. **3**A-**3**C). Although the number and arrangement of the various apertures is identical in all of the figures herein, connectors covered by the appended claims may have any number of apertures and corresponding electrical contacts that are arranged in various configurations.

[0017] Mating face **20** spans between a top portion **21** and an opposing circuit board facing portion **22** of insulative housing **12**. A shrouded AC cable port **70** extends from top portion **21**, and is shown with an external power source, AC cable plug **71**, received therein. As can be seen from **FIG. 2**, AC cable port **70** encompasses tabs **65** associated with the individual AC power contacts **60**, and has an optional locking bar **72** that helps to retain the position of the AC power contacts **60** within insulative housing **12** when AC cable plug **71** is disengaged from tabs **65** (that is, when the external AC power source is removed from the connector).

[0018] Shrouded AC cable port **70** extends from top portion **21** such that the AC power contact tabs **65** can protrude from insulative housing **12** at a position farthest from the circuit board facing portion **22**. This configuration helps to eliminate mechanical and electrical interference of the external AC power supply with the circuit board. If tabs **65** and AC cable port **70** extended from other portions of insulative housing **12**, such as a rear portion (not shown), then valuable board space would be compromised due to the physical space taken up by an engaged AC cable plug **71** and the additional space required for engagement and disengagement of the relatively large plug. Moreover, the probability of electrical interference or electrical creepage increases the closer an external AC power supply gets to a circuit board to which connector **10** is connected.

[0019] A variety of exemplary AC power contact designs are provided that are suitably employed in the connector configuration described above. Referring now to FIGS. **3**A-**3**C, two preferred AC power contact embodiments are shown. AC power contacts **60***a* and **60***b* each comprise two spaced apart contact walls **61** and **62** connected by one or more bridging members **63**. Contact walls **61** and **62** define an engaging portion **64** that is accessible through corresponding apertures **32** located on mating face **20**. Contacts associated with a mating electrical connector (not shown) enter apertures **32** and engage contact walls **61** and **62**. Employing two contact walls can increase the electrical integrity of power connector **10**. Also, the two contact walls **61**, **62** in conjunction with intermediate space **66**, which allows for airflow between contact walls **61**, **62**, increases the ability and rate to dissipate heat generated by power transmission. The difference between the two preferred AC power contact embodiments, is that contact walls **61** and **62** are connected at their bottom edges **67** in AC power contact **60***a*, and are connected at their rear edges **68** in AC Power contact **60***b*.

[0020] Each of AC power contacts **60***a* and **60***b* further comprises tab **65** extending upwardly from a single contact wall **61** for engaging AC cable plug **71**. A reduction in manufacturing costs can be realized by employing only a single tab **65**. Quality issues can also be avoided by employing a single tab **65** because a requirement to "match up" two tabs, one tab extending from each spaced apart contact wall **61** and **62** for proper engagement with an AC cable plug, is completely eliminated. AC power contacts contemplated by the present invention, however, may comprise a tab extending from both contact walls.

[0021] Referring now to **FIG. 4**, three exemplary AC power contacts **60***a* are shown being loaded into connector **10**. A portion **23** of insulative housing **12** underlies each of the AC power contacts to define a gap between connector **10** and a circuit board (not shown) to which the connector is connected so that electrical creepage is minimized.

[0022] A preferred DC power contact **50** is shown in **FIG. 5**, including two spaced apart contact walls **51** and **52** that define an engaging portion **54** are connected by two bridging members **53**. A single bridging member, extending along a minor or major portion of the contact walls **51**, **52**, is also contemplated. This DC power contact configuration provides similar benefits to those described above in conjunction with the preferred AC power contact embodiments. A plurality of terminals **55** extend downwardly from contact walls **51** and **52** for connection to a circuit board. Thus, with power contacts **50** and **60** disposed within housing **12**, terminals **55** extend in a direction that is opposite from tabs **65**. Or in other words, terminals **55** associated with DC power contacts **50** protrude from circuit board facing portion **22** of housing **12**, and tabs **65** associated with AC power contacts **60** protrude from top portion **21** of housing **12**.

[0023] The contact walls and/or bridging element of the AC and DC power contacts, **60** and **50** respectively, may contain notches or other female elements, and/or tangs or other male elements for retaining the power contacts in housing **12**. Preferred power contacts are stamped or otherwise formed as single piece from suitable materials such as phosphor bronze alloys or beryllium copper alloys. Signal contacts **40** (shown in **FIG. 1** disposed in housing **12**) are preferably "pin-type" contacts that include tail portions for connection with a circuit board, and are made from suitable materials, such as, for example, copper alloys. The power and signal contacts may be plated with gold, or a combination of gold and nickel.

[0024] Housing **12** and shrouded AC cable port **70** are preferably molded or formed from a glass-filled high temperature nylon or other materials known to one having

ordinary skill in the art. AC cable port **70** may be integrally molded with housing **12**, or alternatively, be manufactured separately and then coupled to housing **12**.

[**0025**] It is to be understood that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only. Accordingly, changes may be made in detail, especially in matters of shape, size and arrangement of features within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed:

1. An electrical power connector, comprising:

an insulative housing comprising a circuit board facing portion and a mating face including a plurality of apertures therein; and

a plurality of AC power contacts disposed in the insulative housing, each of the AC power contacts comprising an engaging portion accessible through one of the plurality of apertures for engagement with a complementary contact, and a tab extending from the engaging portion and protruding from the insulative housing at a position farthest from the circuit board facing portion for engagement with an AC cable plug.

2. The connector of claim 1, wherein each of the AC power contacts comprises two spaced apart walls.

3. The connector of claim 2, wherein the tab extends from only one of the two spaced apart walls.

4. The connector of claim 2, wherein the two spaced apart walls are coupled by a bridging member.

5. The connector of claim 4, wherein the bridging member couples the bottom edges of the two spaced apart walls.

6. The connector of claim 4, wherein the bridging member couples the rear edges of the two spaced apart walls.

7. The connector of claim 1, further comprising a plurality of DC power contacts.

8. The connector of claim 7, wherein each of the DC power contacts comprises two spaced apart walls and a terminal extending from at least one of the two spaced apart walls for connection to a circuit board.

9. The connector of claim 1, further comprising a plurality of signal contacts.

10. The connector of claim 7, further comprising a plurality of signal contacts.

11. The connector of claim 1, further comprising a shrouded port for shielding the AC power contact tabs and for receiving an AC cable plug.

12 An electrical power connector, comprising:

an insulative housing comprising a mating face including a plurality of apertures therein; and

a DC power contact disposed in the insulative housing including an engaging portion that is accessible through one of the plurality of apertures and is configured for engagement with a contact from a mating connector, and at least one terminal extending from the engaging portion for connection to a circuit board; and

an AC power contact disposed in the insulative housing including an engaging portion that is accessible through another of the plurality of apertures and is configured for engagement with a contact from a mating connector, and a tab extending from the engaging portion for engagement with an AC cable plug;

wherein the at least one terminal and the tab extend in opposite directions.

13. The connector of claim 12, wherein the engaging portion of the AC power contact comprises two spaced apart walls.

14. The connector of claim 13, wherein the tab extends from only one of the two spaced apart walls.

15. The connector of claim 12, wherein the engaging portion of the DC power contact comprises two spaced apart walls.

16. The connector of claim 12, further comprising at least one signal contact disposed in the insulative housing.

17. The connector of claim 12, wherein a portion of the insulative housing underlies the AC power contact to prevent electrical creepage between the connector and a circuit board to which the connector is connected.

18. The connector of claim 12, wherein a direction for interconnecting the connector with a mating connector is orthogonal to the direction the AC power contact terminal extends.

19. An electrical power connector, comprising:

an insulative housing comprising a top portion, a bottom portion, and a mating face extending therebetween; the mating face including a plurality of apertures therein for receiving contacts from a mating connector;

a plurality of AC power contacts disposed in the insulative housing, each of the AC power contacts including an engaging portion comprising two spaced apart walls that are accessible through one of the plurality of apertures and a tab extending from only one of the two spaced apart walls; and

a shrouded AC cable port extending from the top portion of the insulative housing that encompasses the AC power contact tabs and is configured for receiving an AC cable plug.

20. The connector of claim 19, further comprising a plurality of DC power contacts disposed in the insulative housing.

21. The connector of claim 20, wherein each of the DC power contacts comprises two spaced apart walls.

22. The connector of claim 20, further comprising a plurality of signal contacts disposed in the insulative housing.

* * * * *